Notes 03/03

Monday, March 03, 2008
10:05 AM

Coordination Complex

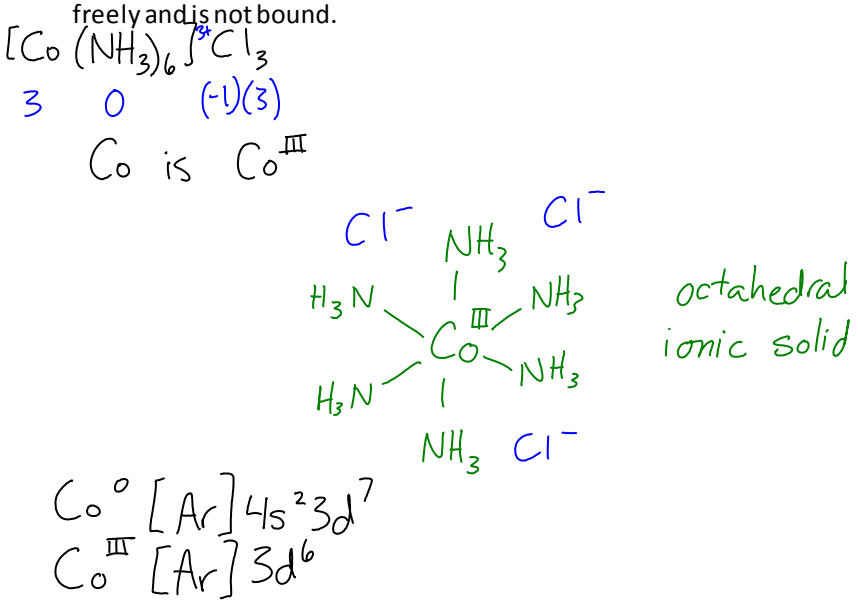
ML_6

L: Ligand (lewis base)
M: metal (lewis acid)

2 types of Valence

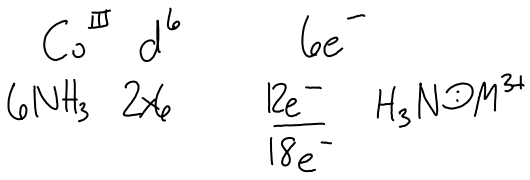
1. Oxidation number
   - has basis in experimental results - Cu^{II} can be confirmed experimentally to gain 2 electrons

2. Coordination number (C.N.)
   - $[Co(NH_3)_6]Cl_3$
     - Outside [ML] brackets is not coordinated to metal. Cl_3 (counter ion or anion) flows freely and is not bound.



Co^0 [Ar] $4s^2 3d^7$
Co^{III} [Ar] $3d^6$

- **18 electron rule**
  - Allows electrons to have stable state just like octet.



  - Titanium can do $14e^-$ since it does not have many d orbitals

- **Examples**
  - $1Cr + yCO \rightarrow Cr(CO)_6$

CO $|C\equiv O|^0$

$Cr^0(CO)_6$

$Cr^0\ [Ar]4s^1 3d^5$ $6e^-$

6 CO 2×6 $12e^-$

$18e^-$

molecular solid

- **Organometallic Complex**
  - Subclass of coordinate compound
  - Direct M-C bond
  - Tend to have low metal oxidation state

M + CO

M - C

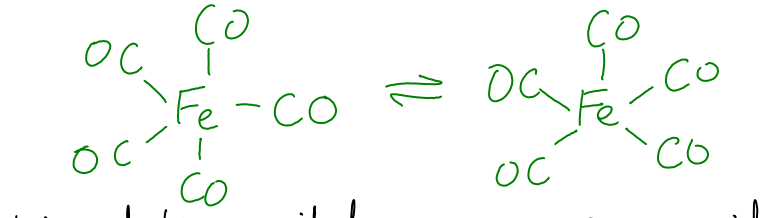
- Fe + CO

$Fe(CO)_5$

Fe $8e^-$

5CO $10e^-$

$18e^-$



trigonal bipyramidal

Square pyramid

- Mn + CO

Mn $7e^-$

6 CO $12e^-$

$19e^-$

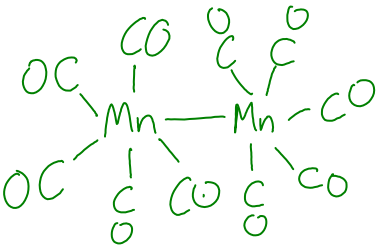
add #

Mn $7e^-$

5CO $10e^-$

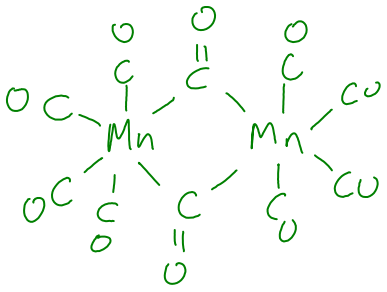
$17e^-$

must be a dimer



Mn° 7e⁻
5CO 12e⁻
1M-M 1e⁻
18e⁻

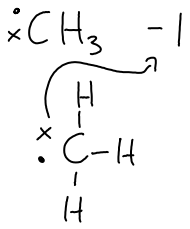
or

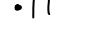


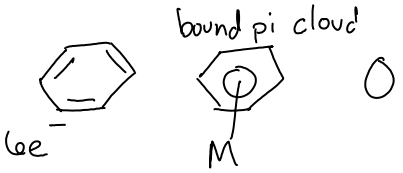
Mn 7e⁻
4CO 8e⁻
2 bridging CO 2e⁻
M-M 1e⁻
18e⁻

- $Co^0(NH_3)_6$ >18e⁻
  9+12=21e⁻ <-- very bad

- **Ligands**

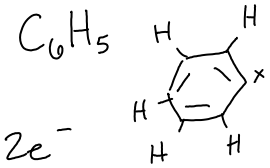






0

Only count pi electrons because they are only ones with correct energy.

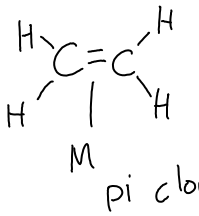


-1

Not bound to pi cloud

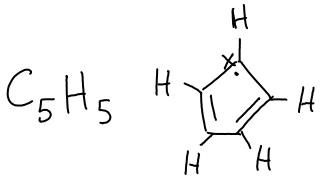
Cl −1 $2e^-$

CO O $2e^-$



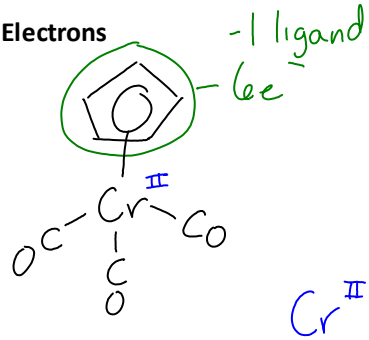
O $2e^-$

O $2e^-$



$6e^-$

- **Counting Electrons**



Cr^{II} $4e^-$

Cp $6e^-$ ← count this way

Cl $2e^-$

2CO $4e^-$

$16e^-$

Other way to count, ignore charges (will find it in books/literature like this sometimes):

Co^0 $6e^-$

Cp 5

Cl 1

CO 4

$\frac{1}{16e^-}$